

PATHWAYS

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No. 2

SOME REFLECTIONS ON THE TEACHING OF SCIENCE

It was a remark made by a young teacher of English that led me to think about this topic. She said, most emphatically, "There is no thinking in Science. We only had to mug up facts for examinations!"

Needless to say when I repeated this comment of hers at a seminar, the teachers of Science were up in arms. Their retort—"It is the only subject which teaches children to observe, to question, to think logically, to solve problems."

Are we doing all those things? Like every other subject, be it History, Geography or English Grammar, there are certainly some facts to be learnt in Science. Remembering these facts is also important, for they need to be repeated in tests, need to be applied both in problems and in real life. It is expected that a child will be able to recall correctly and precisely some definitions, statements and laws. Memorising them helps in their accurate reproduction in tests, where they add to the much needed marks. It prevents students from writing semi-complete answer like this one:

"Boyle's Law: The pressure of a gas is inversely proportional to its volume."

The above statement gets the child no marks for it lacks the all-important conditions that the temperature of the fixed mass of gas must be constant.

However, every teacher of science wants the student to go beyond the stage of recall to understanding and applying the knowledge acquired. Compare the questions marked 1 and 2 in the two sets given here and you will see what I mean.

Set A: Qn. 1 State the properties of an image formed by a plane mirror.

Qn. 2 Sanjay stood in front of a mirror and looked at his image. Which of the following statements are correct?

- i. The image is bigger than Sanjay.
- ii. The image is the same size as Sanjay.
- iii. The image is smaller than Sanjay.
- iv. He saw his image upside down.
- v. He walked two steps backwards and the image moved two steps forward.
- vi. When he raised his right hand, the image raised its left hand.

Set B : Qn. 1 : "Repulsion is [the sure test of a magnet". Explain this statement with suitable examples.

Qn. 2 : Look at these pictures and select the correct answer from those given. Give reasons for your choice.

A B C D Attraction	A B X Y Attraction	Magnet NS P Q Attraction
A B D C Repulsion	B A X Y Attraction	Magnet SN Q P Attraction

- i. AB is a magnet
- ii. CD is a magnet
- iii. Both are magnets

- i. AB is a magnet
- ii. XY is a magnet
- iii. Both are magnets
- iv. AB or XY must be a magnet.

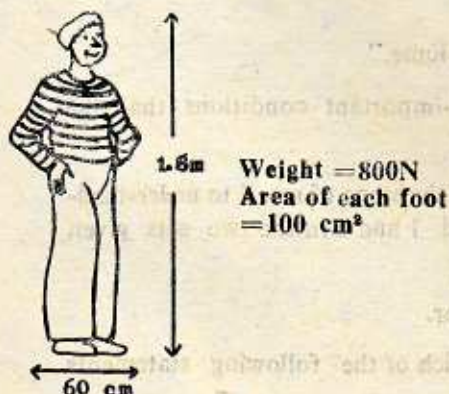
- i. PQ is not a magnet
- ii. PQ is a magnet
- iii. We do not know

Obviously the type of question used in testing the child is important. Another factor we must not forget—have we done it in class before? Very often, in our anxiety to ensure that our students get really good marks, especially if someone else is setting a paper, we give them practice in every possible 'type' of problem. Are we not doing them a disservice? Will this teaching strategy help them to think. Another feature commonly seen in textbooks, especially those written for Primary classes, is a collection of straightforward fact-based questions at the end of each chapter. The children, the parents and very often, the teacher, find in these the easiest way of testing the student. Aply assisted by parents and tutors, children can cram the answers to these questions and repeat them in the test. Correction too, is so easy!

Apart from the conflict between teachers of science subjects and the humanities, it is quite often that one hears a child say, "Science is so difficult. It is a big bore"

Why should this be so? No doubt in the higher classes there is a lot of mathematical calculation involved, but these problems must surely have some physical meaning. Even when we test the ability of a child to substitute numbers into a formula and solve a problem, we can make it interesting by relating it to his own life. This develops problem-solving abilities in the child. Here are two examples :

Example 1 :



Mr Z is a master criminal who plans to steal some valuable jewellery from the museum. It is kept in a special room with a pressure sensitive floor. If the pressure on the floor is more than 0.2 N/cm^2 , an alarm bell starts ringing. What pressure does Mr. Z exert when he stands on the floor? Can he walk across it to remove the jewels? Explain how he could remove them without making the alarm bell go off.

Example 2 : List the different effects of heat. The following substances are heated. In each case write down what effects you would expect to see. The first is done for you : butter— temperature rises, melts (change of state)

Cotton wool, a metal rod, kerosene, milk, water, mud, plastic, glass.

Example 3 : Raju buys six bottles of milk, each bottle containing $\frac{1}{2}$ litre. Each empty bottle weighs 400g. The density of milk is $1.029/\text{cm}^3$. What weight does Raju have to carry home daily ?

A wide variety of types of questions can also make tests more interesting. There can be objective style questions of many types—filling in blanks or completion of sentences, match words in different columns, selecting the correct answer (multiple-choice), identifying 'true' and 'false' statements. Children generally enjoy this type of question and they can be used to test both facts and application of knowledge. Many of these can be quite exciting if presented with a small twist, like these :

Example 1 : Which of the following statements is not true ?

- Silver is an element
- Chlorine and carbon are non-metals.
- Water consists of oxygen and hydrogen chemically combined.
- Copper and iodine are metals.

Example 2 : Complete the following sentences, using a phrase from those given in the brackets.

- A man walking on the street slips on a banana skin and falls, because(it is sticky; his foot crushes it; there is very little friction between his shoe and the ground at that point.)
- The hinges of creaking doors are oiled to.....(reduce noise and wear and tear; keep them black; keep them clean.)
- The easiest way to move a very heavy wooden box is to (move it on a trolley; get friends to help push it; tie a rope to one end and pull.)

Another way of making questions more interesting is to base them on pictures. We often ask students to draw and label conventional diagrams. What about asking them to correct wrongly drawn or incorrectly labelled diagrams? Here are three samples of picture-based question.

Example 1 :



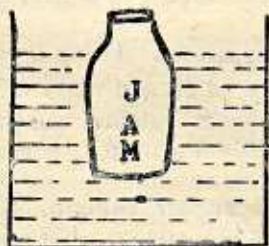
Ram Singh rows his boat with a force of 650 N downstream. The running water applies a force of 500 N. Look at the picture and fill up the blanks selecting one of the words given in the brackets.)

The boat will move.....(upstream/downstream).

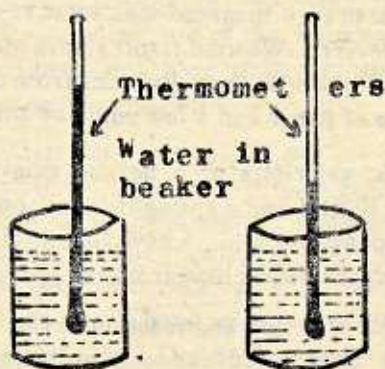
It will move.....(faster/slower)

The resultant force will be.....(150 N/1150 N)

Example 2 : Find the mistakes in these pictures.



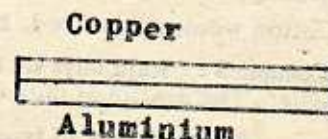
Opening a bottle with a jammed lid by placing it in hot water.



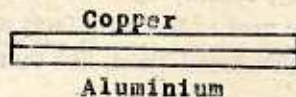
Before and after heating

Example 3 :

A copper-aluminium rod is heated. Copper expands more than aluminium. Before the experiment the rod looked like this :



Afterwards it looked like ? (Tick the correct diagram).



One does not need to be an artist to draw simple pictures. Stick figures, shapes traced from all kinds of books or magazines and slightly modified are usually easy to draw. With a little practice, one spends less and less time on them and it is well worth the effort. Crosswords also provide variety and interest in a test and are a good way to test facts.

The language of science is often 'mysterious', hard to understand, especially when the vocabulary of the science text-book is far more advanced than that of the language text-book in the same class. One solution is to read the text aloud to the class— but how very dull they find it! Can we not explain it first in our own words, using simple language, drawing on the previous knowledge and personal life-experiences of the students? When the text is read subsequently, it not only acts as a revision, but many of the difficult, new words are understood by the context in which they are used.

What is the role of 'experiments' in our teaching of science? Most schools do not have adequate laboratory facilities for junior and middle school classes. The result: no pupil experiments and few if any, teacher demonstrations. "The laboratory is not available to us", is our standard complaint. We must remember this little poem written by a wise Chinese sage :

I hear and I forget
I see and I remember
I do and I understand.

Some simple science activities are possible even in our crowded classrooms. Thermometers can be borrowed and passed around, giving young children an opportunity to learn how to read them. Experiments on volume with measuring cylinders can be performed on a window sill or on a corner table by small groups. I have even managed with some re-arrangement of furniture to get class VII to carry out an experiment on levers. We used retort stands and metre sticks borrowed from the senior laboratory and balanced 25 P coins at various distances from the fulcrum. Plane mirror experiments need only a flat surface, a piece of paper and a few common pins.

All scientific principles need not be demonstrated with traditional apparatus. Using a pair of identical medicine bottles and a spring balance one can compare the weights of oil and water in them and calculate the density of oil. I have found this works even on a toy 'Dynam' balance' using small beakers and a 'weight box' on loan from the laboratory.

The principle of action and reaction can be shown by merely inflating a rubber balloon, holding its mouth tightly closed and suddenly releasing it. Children are thrilled to watch it dart around the room. Many other improvised experiments which illustrate this principle are to be found in books.

Working with their own hands gives the children much—needed confidence, clearer understanding and some of the skills which will help them when they start conventional laboratory work in class IX. It also ensures that they grasp the physical reality of what they learn. This last point is easily demonstrated. Estimate the length of the lines drawn here and then measure them to find out how correct you have been. It is surprising how many adults, let alone children have a clear mental picture of the units they use so often. When children perform simple weighing experiments using an improvised balance and 'weights' made of sandbags they have a clearer picture of the feel of one kilogram, 500 grams and so on. Making a pinhole camera and observing the upside-down image makes the concept so much clearer than learning from a diagram drawn by the teacher on the blackboard. Those lines showing the rays of light now take on meaning. Experimenting with changing the distance between the screen and the pinhole adds to the fun and there is more learning.

While it is not always possible to incorporate this kind of activity into every topic that we teach, we need to try. Starting with the activity and leading through discussion and observation to the concept will involve the student in the best possible kind of learning situation. However, as none of us likes to face failure, it would be wise to always try out the improvisations on our own before asking students to do the experiments. They may face problems which you did not have and need to be encouraged to look for solutions. Each opportunity to solve a difficulty is a valuable experience for the student.

Biology too offers much scope for nature study, and observations out-of-doors need not be made during teaching periods. Maintenance of long-term records is an excellent training in scientific methods of observation and recording. Likewise many simple projects in Physics (and even Chemistry can safely be tried out at home, provided clear instructions with necessary illustrations are given to the students. Almost all schools have cyclostyling facilities and duplication of copies for each student is not a problem. When giving these instructions, make sure that you explain how the project is to be done but not why the model works. The latter must come after discussion when the model has been made and brought to school. Ensure that everyone has done his/her work and don't accept shabby, last-minute efforts. I found this an excellent way of getting even the 'weak' students involved in science. They had a small exhibition of their own work at the end of the term and this was graded and commented on by another teacher. The children were also able to answer questions which she asked them and she found it hard to fault any of them on their models!

By now you must be wondering where one can find the time to do all this and still survive in the day-to-day struggle of school. Looking for new ideas, experiments, questions is a continuous process. I used to collect mine in a file and use them as the need arose. Visiting the school library is essential. Sometimes one has to seek the co-operation of one's colleagues to get an extra period for a demonstration or student experiment; but such 'give and take' goes on all the time in school, doesn't it? Coordination and advance planning with the laboratories ensures that you get the apparatus when you require it and an assistant if needed. It is, no doubt, hard work—but the thrill on the faces of the students makes it all so worthwhile.

Gayatri Moorthy

A GAME FOR LANGUAGE TEACHING

There is no denying the fact that games play an invaluable role in teaching and especially in Language Teaching. A considerable amount of preparation has to go into the creation of such games and the most practical one, is that which can be used at different levels, for the teaching/ revising of various structures.

The 'Lost Property Game' is one of the most true-to-life games that a student can play, since he often has the experience of losing things in the bus, in school and in the playfield.

A series of magazine pictures or outline sketches of the common things that a student would be likely to lose, are pasted on chart paper and these are distributed to each student. The introduction of unusual objects can make it greater fun. With a large group of students, there can be even two pictures of the same object but with different details.

A general questioning session starts off the game in order to introduce the words and structures necessary for the situation. The colour, shape, size, material etc. of the object would be the minimum descriptions required. Useful phrases like 'Can I help you' 'I wonder if.....', 'It certainly should have been.....' etc. could be elicited from students.

One student then plays the role of the office clerk. The pictures given to the students are scrutinized by them secretly, without showing them to the others, and are returned to the

clerk. The game then begins. A student starts describing his own lost object, using all possible vocabulary and structures (without actually naming the object). The clerk should interact with the student and is allowed only one minute for the whole conversation. Within this time the clerk should be able to guess what the lost object is and return it to the student. The fun here lies in the fact that there may be others who may have 'lost' similar objects and unless accurate descriptions are given, the chances of each student getting back his own object are remote. Unusual objects can elicit imaginary stories full of fun and improbabilities.

As the questions and responses are fairly structured, there is little chance of them making many mistakes. Students enjoy the game, since there is a lot of scope for imagination and fiction. These games also relieve the monotony of the chalk and talk language class. It is left to the imaginative teacher to bring in variations in this game. I will be pleased to get a feed-back from any teacher who has tried the game with her students.

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Editor's Note : Why not try this in a Hindi class too ? It provides speaking practice and will help overcome difficulties in gender and *matras*.

—:o:—

Reformers are those who educate people to appreciate what they need.

—E. Hubbard

हिन्दी व्याकरण

आठवीं कक्षा में आने के बाद भी छात्रों में व्याकरण ज्ञान में बहुत कमी होती है और व्याकरण का ज्ञान आरम्भ से दोहराने का पर्याप्त समय नहीं होता है। इसलिए व्याकरण-फाइल बनवाई जाती हैं जिनमें छात्र संज्ञा, सर्वनाम, विशेषण, क्रिया आदि चित्रों द्वारा लिखते हैं। यह कार्य छात्र छुट्टी के दिन करते हैं जिससे उनका समय का सदुपयोग भी होता है। पत्र निबन्ध आदि के नमूने भी रखते हैं जिनमें भाषा के सुधार को ओर ध्यान दिलाया जाता है। इस फाइल में छात्र अपनी कविताएँ, कहानियाँ, नाटक आदि भी लिखते हैं। विशेष कवियों तथा लेखकों के चित्र चिपका कर उनके चरित्र संक्षेप में लिखते हैं। इस कार्य से छात्रों के व्याकरण-ज्ञान में बहुत सुधार हुआ है। छात्र इस विषय में अधिक रुचि से कार्य करने लगे हैं।

(श्रीमती) सरला-दास
संत जेवियर स्कूल,
दिल्ली

बच्चों के विचार

मैंने फाइल का काम समय बिताने के लिए किया। समय तो बीता ही, पर मैं अपना सारा व्याकरण समझ गया।

Kunal Gupta, 8E

इस नए ढंग से मुझे हिन्दी व्याकरण में बहुत रुचि हो गई।

सुमित मंचन्दा, 8E

मुझे इस फाइल के बनाने में कई दिन लगे पर जब यह पूरी बन गई तो मुझे अपने पर गर्व हुआ।

सचिन गोपाल, 8E

मेरी चित्रकारी को बढ़ावा मिला है, कवियों और लेखकों का ज्ञान प्राप्त हुआ है, लेखन-शैली के सरल होने से शब्दकोश का भण्डार बढ़ा है।

Aman Nangia, 8E

हमें सब कुछ याद रहता है। इससे हमारा एक तरह का मनोरंजन हो जाता है।

Sai Krishna, 8E

इस पुस्तक में मैंने चित्र चिपकाकर अच्छी तरह से हर विषय को स्पष्ट किया। ऐसा करके मुझे व्याकरण और भी सरल लगने लगी। मुझे अब फाइल से व्याकरण करने का मजा आता है।

शोतल डावर, 8E

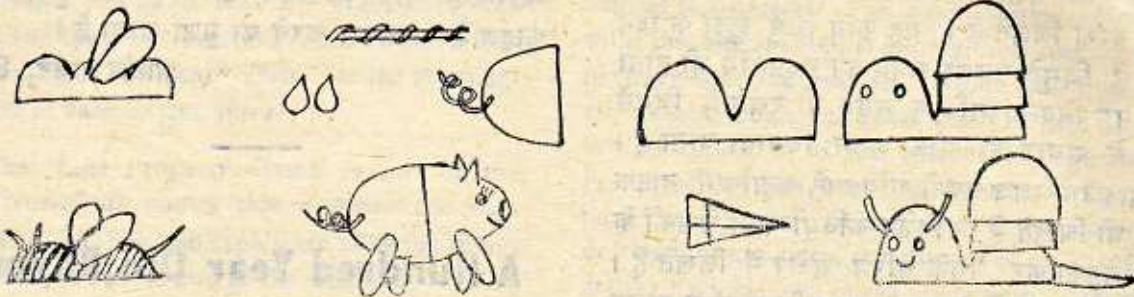
A Hundred Year Old Rhyme

Three little words you often see
Are articles *a, an* and *the*,
A Noun's the name of anything,
As *school, or garden, desk or swing*.
Adjectives tell the kind of noun,
As *great, small, pretty, white or brown*,
Instead of nouns the Pronouns stand—
His head, her face, your arm, my hand.
Verbs tell something to be done—
To *read, count, laugh, swim, jump or run*.
How things are done the Adverbs tell—
As *slowly, quickly, ill or well*.
Conjunctions join the words together—
As *men and women, wind or weather*.
The prepositions stand before
The noun, as *in or through* the door.
The interjections show surprise—
As *oh ! how pretty !, ah ! how wise*.
The whole are called nine parts of speech,
Which *reading, writing, speaking* teach

About a hundred years ago children were being taught this little rhyme. It assumes that the definite and indefinite articles are separate from the other parts of speech, and is a useful way of remembering the functions of the words which are found in sentences. Not, you may say, entirely comprehensive, but at least better than a complete ignorance of the functions of words.

CRAFTY IDEAS

Here is a collection of models to be made with the papier-mache egg trays that one can get from shops. The segments can be glued together or stuck with cello tape. Details for each animal are given below.



THE WASP

Glue or tape paper wings into place on the middle segment. Make two small holes in the head and thread small pieces of straw or pipe-cleaner through. A piece of straw or paper forms the sting.

Paint body in black and yellow stripes.

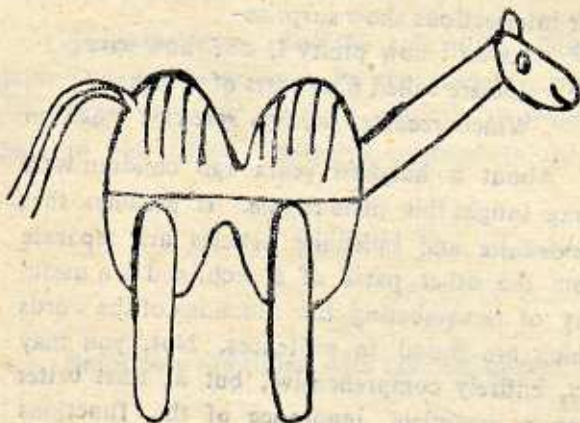
THE PIGLET

Curl a piece of a pipe cleaner or a stiff wire around a knitting needle. Remove and insert into one segment of the egg tray. Tape two segments together. Stick on ears of paper and legs made of cardboard.

Paint the piglet pink and draw the face on with a black felt pen.

THE SNAIL

You need a total of four segments from the egg tray. Keep two of them joined for the body. Add two separate ones, as shown, to make up high shell. Use cardboard for tail and straw for feelers. Paint suitable colour and add the face.



THE CAMEL

This will need two sets of two segments each, 4 'chocobar' sticks for the legs, brown wool for pasting on to the body.

Make a head and neck out of a roll of stiff paper. Use a knife to cut a slit in the body and insert the head unit. Attach the legs with glue. Paint the camel brown and paste little scraps of brown wool on his body to make it look realistic.

A Weekly Class News Programme

Children of all age groups, even the younger ones, seem to show a lot of interest in day-to-day happenings and activities around them. They come to class early in the morning and tell their teachers all the titbits of news they have heard on T.V. or radio or even if they have heard some people talking among themselves about important events. One day we heard two children talking to each other.

"Ramesh ! Yesterday did you see the picture in the front page of the newspaper about how people have died at Qutab Minar. There were three policemen also."

"There were no policemen in the picture of my newspaper. Why were the pictures different; do you know ?"

"No I don't know. Let we ask our Madam."

This conversation set us thinking of finding some way to make them understand about the publication of news in newspaper offices. We thought of introducing a Weekly Class News Programme.

We made a committee consisting of an editor and reporters. We chose a boy or a girl as a reporter from each class. He or she was asked to observe and note the following.

- * all activities undertaken and all creative work done in connection with the different subjects during that week.
- * the result and outcome of any activity like the names of the students who performed very well.
- * the names of the students who had won prizes in any competition, not necessarily held in the school.
- * any other news related to the whole class or the school.

The reporter was then asked to make a report of the weekly activities of his/her class to the Editor. All the reporters submitted their class newsreports to the editor who checked and edited each one with help from the teacher in charge.

Saturday was chosen as the day for the 'Class News'. On Saturday all the reporters would come forward and read their class news. Every week a different child was chosen as a reporter from a class. Thus everybody got a chance to present News from his class. We noticed their interest in Saturday programmes growing more and more. They used to wait eagerly to be chosen as a reporter. They were keen to know what was being done by the children of the other classes.. They clapped and encouraged the children whose names were read out at the programme.

We told them that newspaper offices work in the same way. Just as we compiled all the class news, important news of all the countries of the world is compiled in the newspapers. The newspaper offices also send their reporters to different countries to relay news of that country. The report is edited by the editor and then published in the newspaper. They were keen to find out the names of the local newspapers and their editors. They found out the same and they were told about the different agencies which relay the news like P.T I., U.N.I. and A.F.P.

To this day we are continuing the programme because we feel it has helped us achieve something. Our children have come to know the importance of newspapers as mass media.

They have developed a habit of reading newspaper headlines. They definitely read stories and and poems of the Sunday newspaper with interest. They read the 'Weather' because they have done something about this in class. The advertisements of course interest them a lot. We are glad that our young ones of class I, II, III, come to class with all the latest information; that they are now in touch with the whole world. They learn new words and phrases every day. As their vocabulary increases they use the same words in their writings. We have observed that they express themselves much better now. It has been a great change.

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NEWSPAPER MATH

—FOR CLASS IV

Our thought for the week being "Thinking about others", it was pointed out to the children how fortunate they were in having such lovely homes and parents. From this they were led on to think about children who were not so fortunate and how we could help them. We decided to buy some books, crayons, pencils, educational toys, etc. We thought of ways and means to raise funds for this. After a lot of suggestions from the children it was decided that the easiest way to do this would be for every child to bring old newspapers and from the sale of these we would be able to raise enough money.

It was surprising that what started as a "Helping Project" took a new turn. One morning, as we were tying up the bundles, one little boy piped in with "Mrs. Khosla. How many words do you think there are in one column?" That triggered off a number of questions from the other children which started a new chain of thought. I pointed out to the children that we see mathematical concepts all around us, but one specially good source is the newspaper.

The children had a different homework assignment that day. I asked them to prepare questionnaires under different headings. Here are some questions which came back to me next morning.

1. How many pages are there in a newspaper?
2. Are they the same number every day of the week?
3. How many words in each column?
4. What is the length and width of a single page of the paper?
5. What is its area? Its perimeter?
6. What would be the total area of the newspaper?
7. Which letters occur most frequently?

There were lots of other questions, so we

decided to put them all together. I added some more of my own to develop cards for individual and small group use. Here are some of the cards we made.

ESTIMATING

1. How many words are found in one column?
2. How many words on the front page?
3. In the total newspaper?
4. Find a way of answering these without counting every word on each page.
5. What mathematical concept will be used for this?

MEASUREMENT

1. What is the length and width of a single sheet of the paper?
2. What is its area? Its perimeter?
3. What would be the total area of the entire newspaper?
4. What is the thickness of the newspaper?
5. How many would be needed to make one cm? to make one inch?

GRAPHING

Using the television and radio programmes, construct charts in half hour blocks of time containing the type of programmes being broadcast. Use such groups as plays, film shows, news, sports, educational programmes, children's programmes and miscellaneous shows. Then the children make a graph with this and write down the conclusions drawn from this graph;

1. What programmes are the most frequent?
2. Which are the least frequent?
3. What differences and similarities are there for the different days of the week?
4. What are the reasons for these differences?

II. Make a graph showing how many hours in a week's television programme are for adults, for children, for teenagers.

GEOMETRY

Search for different geometric shapes in the newspaper. How many different shapes can you find?

Name and cut out each of them. From the advertisements cut out labels of different shapes. Can you find any for which you don't know the name?

Can you find any angles in the adverts?

WEATHER

Using the Calcutta Weather column answer these questions.

1. What were the highest and lowest temperature in Calcutta yesterday?
2. What was the maximum and minimum humidity?
3. What was the rainfall?
4. What was the time for sunrise and sunset?
5. Do you notice any difference in this in the last three days?
6. Why is this difference there?

SPORTS

Using information found on the Sports page

make problems from the team scores and individual scores of hockey, football or cricket.

TREASURE HUNT

Working in small groups find these in a newspaper.

1. Fraction
2. Number written in words
3. Time
4. Number between 50 and 500
5. Number greater than 1,000
6. Number greater than 10,000
7. Prime number above 10
8. Date (day, month and year)
9. Measurement of length
10. Amount of money above Rs. 100.

With all these math was fun that week both for the children and the teacher.

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Calcutta



STOP and THINK

In everything you do consider what comes first and what follows, and so approach it. Otherwise you will come to it with a good heart at first because you have not reflected on any of the consequences, and afterwards when difficulties come in sight you will shamefully desist.

— from *Discourses* of Epictetus

Happiness isn't a thing in itself—it's only a *contrast* with something that isn't pleasant.

— Mark Twain

Resolve to perform what you ought. Perform without fail what you resolve.

— Benjamin Franklin

Is not a Patron, my Lord, on who looks with unconcern on a man struggling for life in the water and when he has reached ground, encumbers him with help?

— Samuel Johnson

LIGHT

—A Project for Students of Class III

Project work is perhaps one of the most delightful ways of teaching and learning; an approach which is an integration of English Language, Science and Art—all with an element of creativity. When properly executed, it generates enthusiasm amongst the children and gives a new dimension to classroom teaching.

Just before a set of holidays the children can be prepared for the topic to be dealt with in the coming session. Discussions can be held so that the children remain aware and on their return are ready to carry out the project.

Holiday work—The children can prepare folders out of half a sheet of chart paper. It is folded into two. The lower edge is then folded inwards and gummed or taped at the two outer edges to form pockets. The children may keep their collections and other written material in the folder. The cover may be decorated with drawings or cut-out pictures to make it attractive.

I give below some of the work which my class carried out on this topic.

1. Lights in the Universe

Language : Name the lights you can see in the sky. When can you see these lights? How bright are these lights? Write something about the brightness of the sun, the moon and the stars. How do each of these lights help us? What would happen if these lights were not there?

Imagine that one morning you got up and were told that the sun would not rise that day. Write a few lines about how you would feel if such a thing happened.

2. Creative Art Work : On sheets of drawing or chart paper individual children can make cut-outs of the lights in the universe and colour them.

The teacher can make fairly large cut-outs of the sun, the moon (with its phases) and the stars. The children can then work as groups to cover these with mosaic work using golden and silver paper and waste aluminium foil. These cut-outs can then be strung across the classroom to create a miniature sky.

3. Movement : The children can be asked to try out various body movements suggesting the rising and setting of the sun, the sun at noon, the four main phases of the moon and the twinkling of the stars. These movements could be set to simple yet appropriate music.

4. Scientific Observation : Take a piece of cellophane paper and look at all the lights in the universe through it. What do you see? Write down how each is different. Why do you think it is different?

Take two potted plants and water them every day. Keep one plant in the sunlight and the other in a dark cupboard for three days. Compare the plants. What has happened? Can you notice any difference between the two plants. What do you learn from this experiment?

Take two handkerchiefs and wet them well. Once again keep one out in the sun and the other in the cupboard. After an hour check them. What do you see? What have you understood from this experiment?

Take two metal boxes. Keep one outside in the sun and the other in a cool dark place. After an hour bring the first one in and keep both in front of you. Touch them. How does each feel? Why do you think this is so?

II. Lights in Our Environment

1. Language : What kind of lights are there in your home? in school? Name and draw each of them.

Write a few lines on how each of these lights help you.

Sometimes at night, the lights go off as the electricity fails. What kind of lights do we use then? Name, draw and colour them.

Use the following words correctly to fill in the blanks—

electricity, kerosene, gas, wood, coal, batteries, wax, oil.

- i. Tube lights and bulbs work with.....
- ii. Lanterns and stoves light up with.....
Today.....is used to light our cooking stoves.
However in villages, people still use.....and
- iii. Torches work with.....and a candle is made of.....Diyas are lit with.....

Can you think of any other materials which can be used for lighting?

Complete the story—"One night as we were having dinner, the lights went out....."

III. Lights on Our Roads

1. Language : Name and draw the lights you see on the roads. Write a few lines on how these lights help us. What would happen if these lights stopped working?

Have you noticed some special lights on the roads of Delhi? Where can they be seen? What colour are they? What does the road look like when these are on? Draw and colour these special lights. Find out what they are called.

2. Creative Work : Children can make models or cut-outs of traffic lights. These can be coloured appropriately. Alternatively, coloured glazed or cellophane paper can be used to cover them.

3. Movement : Stop : Wait ! Go! and traffic denote movement. These can be integrated with a poem like this one.

"Stop" says the red light
"Go" says the green
"Wait" says the amber light
"There's traffic in-between."

Just mime with suitable music can be used to create a movement sequence.

IV. Reflection

1. Language If you look into the mirror what do you see? Now just imagine one fine day, you look into the mirror but instead of seeing yourself you see a strange creature—may be a monster! Write a story about these experiences starting it, "One day, when I looked into the mirror, I saw a"

2. Science : Take a mirror, the inside of a biscuit tin and a sheet of dark coloured paper. Look into each of these. Do you see your image in them? How clear is it? What do you learn from this experiment?

You must have often tried to 'shine' a mirror at somebody's face. Try this experiment again and answer the following questions. Do you have to hold the mirror in a special way? Can you 'shine' the mirror from a great distance? Try this experiment in a dark room too and write down what happens. What have you learnt from this? Name some other things which can 'shine' in this way.

Take a small cup and put a teaspoonful of soap powder in it. Pour in some water and mix it well. Take a drinking straw and blow into the soapy water in the cup to make bubbles. Take the cup out in sun. Do you see any colours in the soap bubbles? Write down the names of the colours you see.

V. Light and Dark

1. Language : Blindfold yourself and try walking around your room. How do you feel? Can you move around easily?

Write a small composition starting—"I am a blind boy/girl....."

A PAGE OF FUN

Teacher : Your homework is getting better, Son.

Pupil : I know, my father's stopped helping me.

* * *

What did one maths book say to the other ?
I've got problems !

* * *

Why did the teacher go to the optician ?
Because he had bad pupils.

* * *

Why did the teacher put on the lights ?
Because the class was so dim.

* * *

The kindergarten teacher asked the children if
any of their parents played a musical instrument.
Excitedly one little boy got to his feet and said
very seriously, 'My Dad can play a record player.'

* * *

Teacher : Martin, how do you spell crocodile ?

Martin : KROKODIL

Teacher : The dictionary spells it CROCODILE

Martin : But, Sir, you asked me how I spell it, not
how the dictionary spells it.

* * *

Teacher : The word politics- give me an example
of how to use it.

Pupil : My parrot swallowed a watch, and now
Polly ticks.

* * *

"How old are you, Son ?"

"Nine, Sir."

"And what are you going to be ?"

"Ten, Sir,"

* * *

Teacher : What do you call a cow's skin ?

Pupil : Don't know, Sir.

Teacher : HIDE, my boy, HIDE.

Pupil : Quick boys, under the table.

* * *

What type of feet does a maths teacher have ?
Square feet.

* * *

Teacher : Were you copying his sums ?

Pupil : No, Sir, just looking to see if he got mine
right.

* * *

Teacher (on phone) : You said, Johnny has a cold
and can't come to school ? To whom am I
speaking ?

Voice : This is my father.

* * *

Father : Well, Son, how are your exam marks ?

Son : They're under water.

Father : What do you mean ?

Son : Below 'C' level.

* * *

Teacher : Where's your homework ?

Child : At home.

Teacher : Why ?

Child : Schoolwork is left at school, so homework
is left at home.

* * *

"Miss, do we have to wear school uniform for
this year's outing ?"

"Why ?"

"Well, I'd rather look smart for a change."

* * *

What do you call a jacket on fire ?

A blazer !

* * *

Asked to write an essay on water, a little boy
wrote after a few moments of thought ; 'Water is
a colourless liquid that turns dark when you
wash in it.'

* * *

Teacher : Your homework sum was if a man swims
four miles in one hour, how long would it take
him to swim twenty-five miles ? Why haven't you
done it ?

Pupil : My father isn't back yet, Sir !

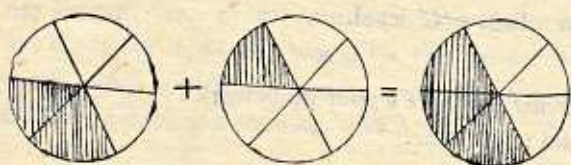
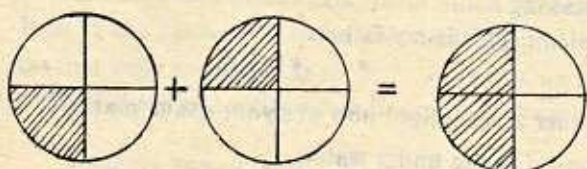
* * *

Understanding Concepts in Fractions Part 2

By Ms. Annie Jose
St. Xavier's School, Delhi

My last article dealt with ways of helping young children understand certain basic ideas about fractions. The same paper strips and circles can be used further as we begin simple operations involving fractions.

Addition and Subtraction of Fractions



This exercise can start with fractions having the same denominator. By placing two quarter-circles in adjacent positions and matching the sum of the two pieces with a whole circle, the children find it equal $\frac{2}{4}$ or $\frac{1}{2}$. Similarly one could extend this to other fractions where the numerators are the same or different.

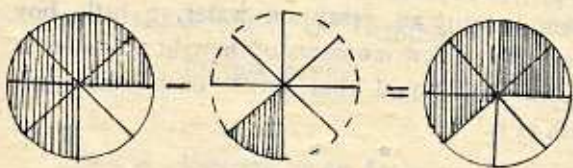
Simple exercises like these are then given for practice.

$$\frac{2}{6} + \frac{1}{6} = \frac{3}{6} \quad \frac{2}{6} + \frac{3}{6} = \frac{5}{6} \quad \frac{2}{3} + \frac{1}{3} = ? \quad \frac{5}{11} + \frac{6}{11} = ? \quad \frac{7}{9} + \frac{1}{9} = ? \quad \frac{1}{12} + \frac{5}{12} = ?$$

From these one can lead the students to a slight variation

$$\frac{5}{8} + ? = \frac{6}{8} \quad \frac{7}{9} + ? = \frac{8}{9} \quad \frac{2}{6} + ? = \frac{5}{6}$$

These equations lead to an explanation that if one-eighth is added to five-eighths it gives six-eighths; hence if one-eighth is removed or taken away from six-eighths it leaves behind five-eighths.



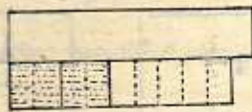
This may be re-inforced by the use of the whole circle and its parts, as shown in this diagram. The addition equations may then be re-written as subtraction equations.

$$\frac{6}{8} - \frac{5}{8} = \frac{1}{8} \quad \frac{8}{9} - \frac{7}{9} = \frac{1}{9} \quad \frac{5}{6} - \frac{2}{6} = \frac{3}{6}$$

Practice exercises to be given after this will be of this type.

$$\frac{4}{5} - \frac{1}{5} = ? \quad \frac{6}{7} - \frac{2}{7} = ? \quad \frac{8}{13} - \frac{5}{13} = ? \quad \frac{9}{15} - \frac{4}{15} = ?$$

The addition and subtraction of fractions with unlike denominators presents the same problem as the comparison of such fractions, which was dealt with in the last article.



To add $\frac{2}{5}$ to $\frac{1}{5}$ one needs to be able to divide them into pieces of equal sizes and compare the sum with a whole. If the two-fifths piece is divided into two equal parts, it becomes equal to four-tenths. Similarly the half can be divided into five equal parts. Now the tenths can be added to give a total of nine-tenths.

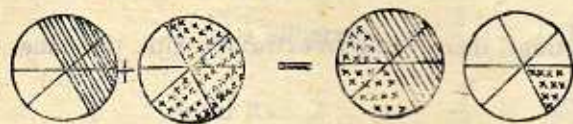
Other examples need to be given of this process, using numbers which are easily manipulated to find the lowest common multiple. At this point the fractions are chosen so that the L.C.M. is only the product of the two denominators. By this, children realise the purpose of finding the L.C.M. Plenty of oral practice can follow and gradually one may introduce denominators where the L.C.M. is not obtained by mere multiplication. For example

$$\frac{7}{9} + \frac{3}{27} = ?$$

$$\frac{6}{9} + \frac{5}{12} = ?$$

$$\frac{4}{15} + \frac{6}{25} = ?$$

This should prevent the possibility of students always multiplying denominators when they add fractions—a habit that one often comes across in later years. It leads to large numbers and complicated reduction of fractions to lowest terms at the last stages of working.



The next step involves addition of fractions whose sum is more than one. Again the paper circles—perhaps of different colours may be used initially. The denominators chosen are initially the same, as in the figure. The children then progress to sums where the L.C.M. has to be found and to the addition of mixed numbers.

The three stages are shown by these examples.

$$\frac{3}{6} + \frac{4}{6} = \frac{7}{6} = 1\frac{1}{6}$$

$$\frac{4}{7} + \frac{2}{3} = \frac{12}{21} + \frac{14}{21} = \frac{26}{21} = 1\frac{5}{21}$$

$$3\frac{1}{2} + 4\frac{1}{4} = 3+4 + \frac{1}{2} + \frac{1}{4} = 7 + \frac{2}{4} + \frac{1}{4} = 7\frac{3}{4}$$

Exercises which follow may give all or some of the steps of the above till the children feel confident to carry on on their own.

The subtraction of unlike fractions presents the same problem as their addition. As before we start with the addition facts.

$$\frac{5}{6} = \frac{2}{6} + ? = \frac{1}{3} + ? \quad \text{Hence} \quad \frac{5}{6} - \frac{1}{3} = ?$$

$$\frac{9}{10} = \frac{4}{10} + ? = \frac{2}{5} + ? \quad \text{hence} \quad \frac{9}{10} - \frac{2}{5} = ?$$

Drill work and practice can be made more interesting by playing a card game. As described earlier these cards are made 15 cm × 10 cm in size from stiff paper. They need to be suitably graded in

order of their difficulty. Each card has on it a selection of fractions. Children are expected to point out three fractions (by placing rings or beads on the fractions) two of which when added together give a sum equal to the third. Some samples are given here to give an indication of how to grade them.

A $\frac{1}{3}$ $\frac{4}{7}$ $\frac{2}{3}$ $\frac{2}{7}$ $\frac{3}{8}$ $\frac{6}{7}$	B $\frac{2}{5}$ $\frac{3}{7}$ $1\frac{1}{5}$ $\frac{3}{5}$ $\frac{9}{10}$ $\frac{4}{5}$	C $\frac{11}{15}$ $\frac{3}{8}$ $\frac{1}{3}$ $\frac{2}{5}$ $\frac{2}{7}$ $\frac{9}{15}$
D $\frac{6}{9}$ $1\frac{7}{20}$ $\frac{3}{4}$ $\frac{7}{12}$ $\frac{3}{9}$ $\frac{3}{5}$	E $\frac{3}{4}$ $\frac{2}{7}$ $\frac{7}{10}$ $1\frac{7}{12}$ $\frac{5}{6}$	F $\frac{2}{3}$ $\frac{1}{2}$ $1\frac{1}{3}$ $\frac{3}{7}$ $\frac{5}{6}$ $\frac{7}{9}$

A. $\frac{2}{7} + \frac{4}{7} = \frac{6}{7}$. Notice that the denominators are the same.

B. $\frac{2}{5} + \frac{4}{5} = \frac{6}{5} = 1\frac{1}{5}$. Notice that the denominators are the same but the answer is more than one. Also children have to be careful in selecting the fractions, there being an extra one with the same denominator.

C. $\frac{1}{3} + \frac{2}{5} = \frac{5}{15} + \frac{6}{15} = \frac{11}{15}$. The denominators are different and the answer is less than one. The L.C.M. is found by multiplication but the answer has to be carefully chosen by the children.

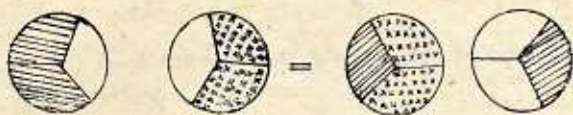
D. $\frac{3}{4} + \frac{3}{5} = \frac{15}{20} + \frac{12}{20} = \frac{27}{20} = 1\frac{7}{20}$. The denominators are different and the answer is more than one. It has also been reduced to its lowest terms. Here too the L.C.M. is obtained by simple multiplication. This will help the teacher detect any tendency amongst students to add together numerators and denominators—another fairly common mistake.

Thus $\frac{3}{4} + \frac{3}{5}$ is not equal to $\frac{3+3}{4+5} = \frac{6}{9}$

E. $\frac{3}{4} + \frac{5}{6} = \frac{9}{12} + \frac{10}{12} = \frac{19}{12} = 1\frac{7}{12}$. Here the denominators are different and the L.C.M. is not found by just multiplication. Simple numbers must be chosen so that the process of mental calculation does not take too long.

F. $\frac{1}{2} + \frac{5}{6} = \frac{3}{6} + \frac{5}{6} = \frac{8}{6} = 1\frac{1}{3}$. Perhaps this is the most complicated card where the denominators are different, the LCM has to be found, the answer is more than one and the fraction has to be given in its lowest terms. The fractions must be chosen so that more than one solution is not possible and certain obviously incorrect ones will be eliminated at a glance.

Multiplication of a Fraction by a Whole Number



The process can easily be explained as one of repeated addition. One-half piece and another half-piece makes one whole. In other words, "Two times a half is equal to one." We can write $2 \times \frac{1}{2} = 1$

A two-third piece and another two-third piece, as shown above make up $1\frac{1}{3}$. This may be written in these ways

$$\frac{2}{3} + \frac{2}{3} = 1 + \frac{1}{3} = 1\frac{1}{3} \quad \text{or} \quad 2 \times \frac{2}{3} = \frac{4}{3} = 1\frac{1}{3}$$

Similarly students can find out from the sixteenth pieces they have that

$$\frac{3}{16} + \frac{3}{16} + \frac{3}{16} = \frac{9}{16} \quad \text{or} \quad 3 \times \frac{3}{16} = \frac{9}{16}$$

Exercises of this type will follow.

$$4 \times \frac{2}{5} =$$

$$8 \times \frac{3}{7} =$$

$$\frac{3}{4} \times 12 =$$

Sums given earlier may be repeated now with a different purpose.

$$\frac{2}{3} \text{ of Rs. 18} = \frac{2}{3} \times \text{Rs. 18} =$$

$$\frac{1}{20} \text{ of a metre} = \frac{1}{20} \times 100 \text{ cm} =$$

$$\frac{1}{4} \text{ of a kilogram} = \frac{1}{4} \times 1000 \text{ g} =$$

$$\frac{1}{5} \text{ of Rs. 2} = \frac{1}{5} \times 200 \text{ p} =$$

Gradually problems involving cancelling may be introduced. Some possible explanations are suggested below.

$$\frac{3}{4} \text{ of 100 is the same as 3 times } \frac{1}{4} \text{ of 100} = 3 \text{ times } 25 = 75$$

$$\frac{2}{3} \text{ of Rs. 18 is either } \left(\frac{1}{3} \text{ of Rs. 18} \right) + \left(\frac{1}{3} \text{ of Rs. 18} \right) \text{ or two times } \left(\frac{1}{3} \text{ of Rs. 18} \right)$$

$$= 2 \text{ times } \frac{1}{3} \times 18 = \text{Rs. } 2 \times 6 = \text{Rs. 12}$$

Very often students develop a habit of multiplying all the numerators together and then all the denominators. The answer which they get is then reduced to lowest terms by a series of cumbersome cancellation operations.

Multiplication of a Fraction by another Fraction is somewhat more difficult to understand. I then proceed in this way.

What is six times a half? Three.

Therefore $\frac{1}{2}$ of 6 is 3. Proceed to find the values of

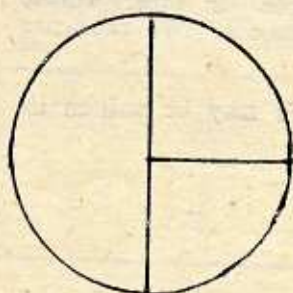
$$\frac{1}{2} \text{ of 5} = 2\frac{1}{2},$$

$$\frac{1}{2} \text{ of 4} = 2,$$

$$\frac{1}{2} \text{ of 3} = 1\frac{1}{2},$$

$$\frac{1}{2} \text{ of 2} = 1$$

A strip of paper marked off in unit divisions placed on the flannel board can be folded accordingly and used to show these equations. If students can cut strips themselves, they will be convinced of the truth of these equations more easily.



Having found the halves of all these whole numbers, the students proceed to find half of a half. A half circle is cut into two parts and each is compared with the whole. Thus "half of a half is one-quarter, similarly half of a quarter is one-eighth".

Thus we can write

$$\frac{1}{2} \text{ of } \frac{1}{2} = \frac{1}{2} \times \frac{1}{2} = \frac{1}{4} \text{ and } \frac{1}{2} \text{ of } \frac{1}{4} = \frac{1}{2} \times \frac{1}{4} = \frac{1}{8}$$

Further practice could be given using pieces of the circle which are divided into thirds. Now the following equations would emerge.

$$\frac{1}{2} \text{ of } \frac{1}{3} = \frac{1}{3} \times \frac{1}{2} = \frac{1}{6}$$

$$\frac{1}{3} \text{ of } \frac{1}{3} = \frac{1}{3} \times \frac{1}{3} = \frac{1}{9}$$

$$\frac{1}{2} \text{ of } \frac{2}{3} = \frac{1}{2} \times \frac{2}{3} = \frac{2}{6} = \frac{1}{3}$$

These may be presented on a flannel graph.

Thus to multiply a fraction by another fraction, the numerator of the first is multiplied by the numerator of the second; the denominator of the first by the denominator of the second. The resulting fraction is their product.

The previous multiplications may now be written as

$$\frac{1}{2} \times 5 = \frac{1}{2} \times \frac{5}{1} = \frac{5}{2} = 2\frac{1}{2}$$

$$\frac{1}{2} \times 4 = \frac{1}{2} \times \frac{4}{1} = \frac{4}{2} = 2 \text{ and so on}$$

Now the above rule becomes applicable whether the fraction is multiplied by a whole number or another fraction. Practice exercises follow.

Division of fractions

Again we start with a half-circle and the students are asked to cut it into two equal parts. Please note the change in the language used. This is an important part of building up the concept. The result of the exercise leaves the student with two quarter circles.



Thus $\frac{1}{2} \div 2 = \frac{1}{4}$ experimentally. A two-third strip is cut from a whole and again cut into two equal parts. On comparing with the whole each part is found to be one-third. Thus $\frac{2}{3} \div 2 = \frac{1}{3}$

More division equations of this type could be obtained.

$$\frac{1}{4} \div 3 = \frac{1}{12}$$

$$\frac{1}{6} \div 4 = \frac{1}{24}$$

$$\frac{2}{3} \div 6 = \frac{2}{18} = \frac{1}{9}$$

Now the students are directed to compare the division equations with the multiplication equations learnt earlier.

We know $\frac{1}{2} \times ? = \frac{1}{4}$

$$\frac{2}{3} \times ? = \frac{1}{3}$$

and $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$

$$\frac{2}{3} \times \frac{1}{2} = \frac{1}{3}$$

We found out that $\frac{1}{2} \div 2 = \frac{1}{4}$

$$\frac{2}{3} \div 2 = \frac{1}{3}$$

Therefore $\frac{1}{2} \div 2 = \frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$

$$\frac{2}{3} \div 2 = \frac{2}{3} \times \frac{1}{2} = \frac{1}{3}$$

Thus dividing a fraction by another fraction means multiplying by the reciprocal of the second fraction. Dividing a fraction by a whole number like 2, 4, 6 means multiplying it by $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{6}$, respectively. Examples involving units may now be added.

If four balloons cost Rs. 3, what will one balloon cost ?

If $2\frac{1}{2}$ m of cloth is cut into five pieces, how long is each piece ?

Now as a last step, try the following examples

$$\frac{2}{5} \div ? = 1 \quad \frac{2}{5} \div \frac{2}{5} = \frac{2}{5} \times \frac{5}{2} = 1$$

$$\frac{3}{4} \div ? = 1 \quad \frac{3}{4} \div \frac{3}{4} = \frac{3}{4} \times \frac{4}{3} = 1$$

These would help to explain why the fractional divisor is inverted.

Using the number line in order to teach fractions and also to give concepts about operations involving fractions is important. This article had a limited objective of clarifying only some concepts, hence that exercise is left to the readers.

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